

**U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
OFFICE OF QUALITY ASSURANCE**

AUDIT REPORT

OF

LOS ALAMOS NATIONAL LABORATORY

AT

LOS ALAMOS, NEW MEXICO

OCTOBER 19-22, 1998

Prepared by: _____ **Date:** _____

**Donald J. Harris
Audit Team Leader
Office of Quality Assurance**

Approved by: _____ **Date:** _____

Robert W. Clark
Acting Director
Office of Quality Assurance

1.0 EXECUTIVE SUMMARY

This performance-based Quality Assurance (QA) audit was conducted at Los Alamos National Laboratory (LANL), Los Alamos, New Mexico, October 19-22, 1998, to evaluate Milestone Report SP32E2M4SZ, Reinterpretation of Reactive Tracer Test in Bullfrog Tuff and the Results of Laboratory Testing (C-Hole Update Report). The audit team determined that, with the exception of those areas where conditions adverse to quality were identified. LANL has effectively implemented the critical process steps for the preparation of the Milestone Report. In addition, the technical evaluation of the milestone determined the scientific work was of good technical quality. However, the audit team concluded the report should be revised to provide detail quantification of the sensitivity and uncertainty (refer to Recommendations).

Three conditions adverse to quality were identified as a result of the audit. Unqualified C-Well Core was relied on in the laboratory testing, Difcel Software was utilized to perform interpretations of data, and Scientific Notebooks (SN) were not processed to the Records Processing Center (RPC) after close out by the Principal Investigator (PI). Details of the conditions adverse to quality are presented in Section 5.5 of this report. The audit team also identified five Recommendations during the audit. These Recommendations are detailed in Section 6.0 of this report.

2.0 SCOPE

The audit was conducted to evaluate the technical adequacy of LANL deliverable (Milestone Report) and the effectiveness of critical process steps implemented during the preparation of the deliverable:

- Work Breakdown Structure (WBS) 1.2.3.3.1.3.1, Reactive Tracer Testing C-Wells, Milestone SP32E2M4SZ, Reinterpretation of Reactive Tracer Test in bullfrog Tuff and Results of Laboratory Testing (C-Hole Update Report)

The audit team conducted interviews and reviews of documentation in accordance with the approved Audit Plan to evaluate the adequacy of the deliverable and effectiveness of the critical process steps.

2.1 Process Steps/Products/Documentation

The performance-based evaluation was based upon the following:

1. Satisfactory completion of critical process steps.
2. Acceptable results and quality of the end product.
3. Documentation that substantiates the quality of products.
4. Performance of trained and qualified personnel.
5. Implementation of applicable QA program elements.

The following critical process steps were considered during the evaluation of Milestone Report SP32E2M4SZ:

1. Scientific Investigation Planning.
2. Identification, Traceability and Control of Data.
3. Data Analysis, Review and Interpretation.
4. Control of Software.
5. Model Development Code, Validation, Calibration and Output Reporting.
6. Independent Review of Study Results.
7. Data Input to Genesis.
8. Identification of Cited References to TIC.

2.2 Technical Areas

The audit included a technical evaluation of the adequacy of the Milestone Report. Details of the technical evaluation are documented in Section 5.4 of this report.

3.0 AUDIT TEAM AND OBSERVERS

Name/Title/Organization

- Donald J. Harris, Audit Team Leader, Office of Quality Assurance (OQA)
- Kenneth t. McFall, Auditor, OQA
- Keith Kersch, Technical Specialist, Civilian Radioactive Waste Management System Management and Operating Contractor (CRWMS M&O)
- Jeff Ciocco, Observer, U.S. Nuclear Regulatory Commission (NRC)
- Ted Carter, Observer, NRC
- Susan Zimmerman, Observer, State of Nevada

4.0 AUDIT TEAM MEETINGS AND PERSONNEL CONTACTED

A pre-audit meeting was conducted at LANL on October 19, 1998. Daily debriefings were held to apprise LANL management and staff of the progress of the audit and of any identified conditions adverse to quality. A post-audit meeting was conducted at LANL on October 22, 1998.

Personnel contacted during the audit, including those that attended pre- and post-audit meetings, are listed in Attachment 1.

5.0 SUMMARY OF RESULTS

5.1 Program Effectiveness

With the exception of the areas where conditions adverse to quality were identified, the audit team concluded that critical process steps applicable to the preparation of Milestone Reports were effectively implemented.

5.2 Stop Work or Immediate Corrective Action Taken

There were no stop work actions or immediate corrective actions taken as a result of the audit.

5.3 QA Program Implementation of the Elicitation Procedure

A summary table of audit results is provided in Attachment 2. Details of the audit, including the objective evidence reviewed, are documented in the audit checklist. The checklist is maintained as a QA record.

5.4 Technical Audit Activities

Mr. Paul W. Reemus is the PI for the Milestone audited. It was noted during the interviews with the PI and LANL staff members that they appeared to have a good grasp of the requirements to support the Milestone Report activities. LANL was very cooperative and helpful during the audit.

The audit team was first provided with a draft version of the Milestone, dated September 3, 1998. At the beginning of the audit, the team was given the most recent version of the report, dated September 15, 1998. The audit team preparation for this audit was based on the first version of the report. The preparation would have been more effective if the final version of the report had been provided earlier.

The audit team could not examine all of the laboratory notebooks used nor interview all of the personnel who work on the project. Some of the laboratory notebooks were in the field, others were in the possession of a worker at New Mexico Tech. One of the researchers was located in Socorro, New Mexico, another was on vacation in Hawaii, and others were working at the Nevada Test Site.

The work planning process has not adequately been defined as of this audit. The controlling procedure, LANL YMP-QP-0343, still addresses Study Plans which were withdrawn (Reference LVMO-98-D-027). The Statement of Work (SOW) associated with this Milestone contains four sentences in the Fiscal Year (FY)1998 SOW. The PI utilized the SOW, withdrawn Study Plan, and the Field Work Package for C-Hole Complex Saturated Zone-Tracer Testing (FWP-SBT96-09, Revision 02) for planning. Additional planning was detailed in several areas in the SNs that were examined. Only through interviews with the PI and LANL staff could the audit team identify the specific planning documents and their applicability as well as the various locations of the planning in the SNs. LANL Engineering Assurance and the OQA Representative are currently developing a work authorization process which will require planning to be performed prior to the initiation of any work activity.

The Milestone SP32E2M4SZ Report audited, supports WBS 1.2.3.3.1.3.1 Hydrologic Testing for License Application. The information developed is critical to the development of the safety case for the Yucca Mountain Project. This information included confirmation of the conceptual model for sorption, diffusion, and dispersion of solutes in the saturated zone, and determination of the coefficients of this model. It provides an update of the results and interpretation of the reactive Tracer Test conducted in the Bullfrog Tuff at the C-Holes and includes an update of all laboratory testing conducted to date in support of reactive Tracer Testing at the C-Holes. The laboratory test refined the interpretations of the FY1997 Bullfrog reactive Tracer Test as well as the test that supports the predictions/interpretations of the Prow pass Reactive Tracer Test scheduled for late FY1998.

The completed Milestone is like an interim report which is scheduled to flow into a Level 3 Milestone SP32E1M3, due early next year. The audit team determined that the science was technically okay. However, it appeared that the PI pursued the science at the expense of the programmatic requirements. The three main criticisms of the Milestone are: (1) Laboratory experiments were performed on unqualified core taken from C-Wells; (2) Some of the analysis were made using unqualified software (DIFCEL); and (3) Only partially satisfied the requirements

of the Natural Environment Program Operations (NEPO) guidance on implementing the “Interim Direction for Document Development” of July 15, 1998.

5.5 Summary of Conditions Adverse to Quality

The audit team identified three conditions adverse to quality during the audit. Corrective action for two of the conditions will be addressed in response to the OCRWM deficiency documents identified in Section 5.5.2 of the report and one of the conditions adverse to quality was corrected during the course of the audit and is addressed in Section 5.5.4 of the report.

5.5.1 Corrective Action Request

None.

5.5.2 Deficiency Reports (DR)

DR LANL-99-D-XX

The Milestone contains Q data which may be relied upon to address safety and waste isolation issues. LANL derived laboratory test data from unqualified C-Well Core.

DR LANL-99-D-XX

Acquired and modified DIFCEL Software was utilized to perform interpretation of data for the Milestone. The software has not been qualified and does not meet the requirements of the Quality Assurance Requirements and Description (QARD) document.

5.5.3 Performance Reports

None.

5.5.4 Conditions Adverse to Quality Corrected During the Audit (CDA)

SNs LA-EES-4NBK-96-002(b) and LA-EES-4NBK-96003 Reactive Tracer Testing, had technical reviews completed on May 28, 1997, by Larry S. Hersman and a subsequent closure statement by the PI. No other entries were in the SNs. They were sitting on the shelf and no copies had been submitted to the RPC. The SNs were processed through Engineering Assurance Reviews and submitted to the RPC.

5.5.4 Follow-up of Previously Issued Deficiency Documents

LVMO-98-D-027, Planning Scientific Investigations

LANL Engineering Assurance and the OQA on-site representative are in the process of drafting a quality planning procedure similar to Sandia National Laboratories' Work Authorization procedure. This should be available by November 30, 1998.

6.0 RECOMMENDATIONS

The following recommendations resulted from the audit and are presented for CRWMS M&O and LANL management consideration:

1. Strickler (1998) specifies in Section 3.5 that all references in project documents should be in the Technical Data Management System (TDMS) and that references contain a data tracking number. Not all of the references in the deliverable had been submitted to the RPC. Some of the references did not have accession numbers listed. Other references are listed as "personal communications," and "unpublished reports," which cannot be verified by outside reviewers. All references should be available for outside reviewers by including them in the project records system. It is recommended that the report be revised to comply with Strickler's guidance.
2. Sensitivity and uncertainty are not well quantified in the Milestone Report. Users of the data will need to know the accuracy of the results. We recommend that the Milestone Report be revised to include more detailed quantification of sensitivity and uncertainty. Some examples of the need for this quantification follow:
 - i. In the middle of page 4.1, there is a listing of an assumed value of grain density for central Bullfrog Tuff of 2.65. At the bottom of page 2.11 it lists a bulk density of 1.9 with porosity of 0.1 for this same interval. This corresponds to a grain density of 2.6. The project database lists even different values (see tracking number MO9708RIB00040.000). Grain density measurements have been made and some of these values are listed in project

- data bases. The range of these measured values should be examined, and included in the report.
- ii. The analyses of field transport in this report are based on the assuming that the flow path is a homogeneous, isotropic, continuum, yet it is known that the rock is anisotropic and non-homogeneous, with discrete flow paths. There is uncertainty in the assumed thickness of the flow paths that has a significant impact on the results of some of the analyses.
 - iii. The assumption is made that the Bullfrog Tuff is nonleaky (page 1.1 near the bottom) based on the work of Geldon. In the same paragraph the authors acknowledge that there were pressure responses in other intervals during flow tests.
 - iv. At the bottom of page 2.26 it states that results "...were not very sensitive to fracture sorption parameters." This statement needs to be quantified.
3. Interface definition is needed for this Milestone. This Milestone contains the results of several analyses, interpretations, and laboratory measurements. It is not clear how these results will be used and who will be using them. It would improve the process if the user of the results could be identified and the form and format of the needed results specified in writing. A process similar to that specified in NLP 3.34 (reference 1) below is recommended. In this process, the information developer and information user specify in writing what results are needed and the form of the results.
4. In some instances it appears that some laboratory data were recorded initially on informal sheets and later transcribed onto official notebooks or spreadsheets. Data should be recorded directly into laboratory notebooks or data sheets that are captured by the records system.
5. Equation 5.2 contains a typographical error that should be corrected.

References

1. *CRWMS M&O, Nevada Local Procedure (NLP-3.34), MDGS Interface Control Documentation, Revision 1, August 13, 1998.*
 2. *Strickler, R.L., 1998. Interim Direction for Document Development, Memo to D. R. Wilkins, J. N. Bailey and C. A. Heath, dated July 2, 1998*
6. LANL should expedite the development of their Scientific Planning Procedure that they are currently drafting. The procedure is similar to SNL's concept to control scientific planning at the laboratory.

7. The use of unqualified software should not occur at this stage of the Project.
8. Ensure the NEPO guidance on implementing the “Interim Direction for Document Development” is implemented on future deliverables.

7.0 LIST OF ATTACHMENTS

Attachment 1: Personnel Contacted During the Audit

Attachment 2: Summary Table of Audit Results

Attachment 2 Summary Table of Audit Results

ATTACHMENT 1

Personnel Contacted During the Audit

<u>Name</u>	<u>Organization/Title</u>	<u>Pre-audit Meeting</u>	<u>Contacted During Audit</u>	<u>Post-audit Meeting</u>
Tom Chaney	USGS/EA Chief	X	X	X
Robert Craig	USGS/TPO	X	X	X
Joyce Golos	USGS/Admin Officer	X		
Martha Mustard	USGS/Hydrologist	X	X	X
Bruce Parks	USGS/Team Chief, Seismotronics	X	X	X
Richard Quittmeyer	M&O/WCFS/SPO Staff	X	X	X
Patricia Sheaffer	USGS/QA Implemnetation Specialist	X	X	X
Donna Sinks	OQA/QA Specialist	X		
Carl Stepp	M&O/WCFS/PSHA Project Director	X	X	
Ardell Whiteside	OQA/QA Specialist			X
John Whitney	USGS/Tetronics Chief	X	X	X
Ivan Wong	M&O/WCFS/PSHA Deputy	X	X	

	Project Director			
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Legend:

EA	Engineering Assurance
TPO	Technical Project Officer
WCFS	Woodard Clyde Federal Services
OQA	Office of Quality Assurance
NRC	Nuclear Regulatory Commission
SPO	Site Program Operations
PSHA	Probabilistic Seismic Hazards Analysis

ATTACHMENT 2

AUDIT USGS-ARP-98-01 - DETAILED SUMMARY FOR EVALUATION OF EXPERT ELICITATION PROCESS

Activities	Process steps/MGMT Objectives	Details (Checklist)	Deficiencies	REC	Process Eff.	Product Adequacy	Overall
Scientific Expert Elicitation for PSHA	Process control established for elicitation	pgs. 1-6	N	#1	SAT	SAT	SAT
	Definition of Objectives	pg 7	N		SAT	SAT	
	Selection and Training of Experts	pgs 3, 8, 9, 11	N		SAT	SAT	
	Assemble and Disseminate Basic Information	pgs 5, 10, 20, 22, 25, 26	N		SAT	SAT	
	Management of Judgements (elicitation, feedback, and aggregation)	pgs 12-17, 20-43	N	#2, 3 #5, 6 #7	SAT	SAT	
	Documentation and Preparation of Report	pgs 6, 18,19	N	#4	SAT	SAT	

SUMMARY TABLE OF AUDIT RESULTS FOR PROCEDURAL COMPLIANCE EVALUATIONS

QA Element	Document Reviewed	Details (Checklist)	Deficiencies	REC	Process Eff.	Product Adequacy	Overall
2.0	YMP-USGS-QMP-3.16, R0	Page 3	CDA #1	N	SAT	SAT	SAT
5.0	YMP-USGS-QMP-3.16, R0	Pages 1-6	N	N	SAT	SAT	SAT